PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C25F 3/16, 7/00, B23H 9/00, B24D 17/00, 18/00

A1

(11) International Publication Number: WO 99/10569

(43) International Publication Date: 4 March 1999 (04.03.99)

(21) International Application Number: PCT/SG97/00051

(22) International Filing Date: 3 October 1997 (03.10.97)

(30) Priority Data:
9/226923 25 August 1997 (25.08.97) JP

(71) Applicant *(for all designated States except US)*: UNIQUE TECHNOLOGY INTERNATIONAL PTE. LTD. [SG/SG]; Block 21 Kallang Avenue, #04–165 Kallang Basin Industrial Estate, Singapore 339412 (SG).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: TANI, Kazunori [JP/JP]; International Business Park #03–03, Singapore 609915 (SG). KAWACHI, Kohichi [JP/JP]; Kanbo Create Co., Ltd., 6–9, Bakuromachi 1–chome, Chuo–ku, Osaka (JP).

(74) Agent: HAQ, Murgiana; Haq & Namazie Partnership, Robinson Road Post Office, P.O. Box 765, Singapore 901515 (SG).

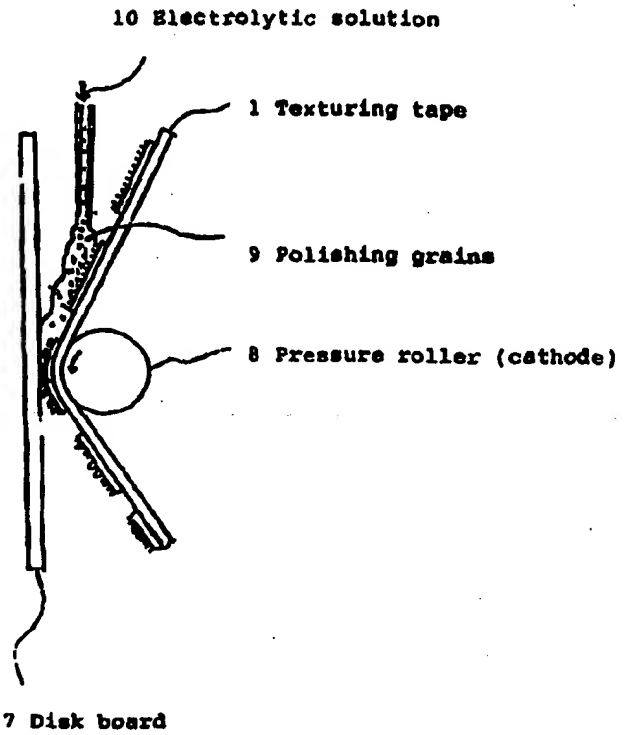
(81) Designated States: JP, KR, SG, US.

Published
With international search report.

(54) Title: COMBINATION ELECTROLYTIC POLISHING AND POLISHING AND TEXTURING MACHINE AND THE COMBINATION ELECTROLYTIC POLISHING AND POLISHING AND TEXTURING TAPE USED IN THE SAID MACHINE

(57) Abstract

Objective: to provide a combination electrolytic polishing and polishing and grinding machine and processing tape which will enable the formation on the surface of hard disks uniform, accurate texturing without abnormal protrusions. Composition: a polishing and texturing machine and processing tape in which a layer which can hold polishing grains is formed with flocking or foam resin on one surface of tape–shaped backing, such as synthetic resin film or woven material or non–woven cloth, and electrolytic solution into which polishing grains have been dispersed is supplied to this tape to conduct polishing or texturing of the hard disk board, at the same time as which a voltage is applied between the electrode established close to the surface being processed and the disk board to enable electrolytic polishing. Effect: simultaneous mechanical processing and electrolytic polishing enables the efficient provision of hard disks in one–stage processing with surface properties equal, or superior to those produced in two–stage processing.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Title of Invention

Combination Electrolytic Polishing and Polishing and Texturing Machine and the Combination Electrolytic Polishing and Polishing and Texturing Tape used in the said Machine.

Detailed Explanation of the Invention

(0001)

INDUSTRIAL FIELD OF UTILISATION

This invention relates to machines for the polishing and grinding of surfaces of boards and other items for hard disks, and the tape used in these machines, and in particular relates to polishing and texturing machines which are able to perform electrolytic polishing of the surface of boards and the like while simultaneously polishing and grinding, and the tape for use in these machines.

(0002)

PRIOR ART

Hard disks, that is metallic, thin-film magnetic disks, are generally magnetic memory media with a magnetic layer on the surface of an aluminium disk board; but with constant hopes for further improvement in the memory density there is the impending necessity for a reduction in the distance between the magnetic head and magnetic disk. Bringing both of these surfaces to a smooth, mirror-like finish, however, creates excessive contact areas in both, obstructing smooth running, and giving rise to problems upon start-up in particular. To deal with this problem, polishing and texturing is generally conducted in which filament print of ridges and grooves is created through grinding after the surface of the disk board has been polished smooth. The polishing process is performed by supplying a polishing cloth with a polishing solution that contains grains to bring the surface of the disk board to a mirror-like surface. The texturing process uses items such as tape which has polishing grains fixed in its surface, or buffs impregnated with slurries which contain polishing grains to form approximately concentrically circular filament print on the surface of the disk board. To achieve ensured smooth running of the disk and high memory density, polishing and texturing must be performed so as there are no abnormal protrusions on the surface, and the ridges and grooves are accurate and even. In normal polishing and grinding with polishing grains, however, deep ridges and large protrusions are frequently formed, leading to read-write errors and problems with the floating stability of heads in these areas.

(0003)

PROBLEMS THE INVENTION SEEKS TO SOLVE

The task for this invention is to create disk boards with surface properties whereby the surface has no protrusions, the surface roughness Ra (average roughness of concentric lines) is no more than 50 Å and the maximum surface roughness Rmax (the maximum height of surface protrusions) is no more than 50 Å. To achieve this, it is necessary to both process the surface of the disk board to a high-precision mirror finish, and create grooves of uniform depth in that surface. Boards are generally polished to a superior mirror finish by using finer polishing agents, but this leads to reduced processing efficiency and poor productivity. Furthermore, once a large processing mark, or scratch is made, its removal reduces processing efficiency and requires significant amounts of processing time. As far as texturing is concerned, it is difficult to improve surface properties through mechanical means. Other issues that this invention seeks to address is the improvement of processing efficiency and the expediting of the production of uniform surface properties.

(0004)

MEASURES FOR SOLVING THE PROBLEMS

In addressing the aforementioned problems, the inventors of this invention have removed the minute protrusions that occur when polishing with filings and when forming process marks, and burring that occurs when processing, by utilising the action of electrolytic polishing in concurrence with polishing and grinding under the concept of producing a smooth processed board with no abnormal protrusions; that is to create superior texture patterns on highly polished, mirror-finish boards. This invention is the result of repeated experiments, evaluations and investigations. In other words, the substance of this invention is: 1) a device with which electrolytic polishing and polishing and texturing can be conducted simultaneously, whereby in the polishing and texturing process by tape with a metallic surface, the object being processed functions as an anode, a cathode is positioned near the surface being processed to conduct electrolytic polishing, and solution of combined electrolytic solution and processing solution is present between, and in contact with, the surface being processed and the cathode, and; 2) the polishing and texturing tape used in the said device. Furthermore, the cathode may be positioned on the processing side of the tape or on the reverse side of the surface being processed. The tape's backing may be synthetic resin film, woven material or non-woven cloth, and has a surface on one side of flocked fibres or a porous, synthetic resin foam which is capable of holding polishing grains. In devices in which the cathode is positioned on the reverse side of the surface being processed, non-conductive liquid-permeable is used. Confirmation was made that through the use of this invention's device processes were simplified, surface properties superior to the two-stage processing method were obtained, and processing efficiency was boosted approximately ten-fold.

(0005)

The most significant feature of this invention is that the addition of electrodes to the polishing and grinding device allows for the simultaneous and parallel conducting of mechanical polishing and grinding, and electro-chemical polishing by combining electrolytic solution with polishing or grinding solution and passing a current between the solution and the object being processed. The electrode (cathode) is formed by placing a cathode roller or cathode rod (Diagram 3) on the processing side of the tape in proximity to the surface being processed. Alternatively, the pressure roller on the reverse side of the tape may act as an electrode. It is also possible to have the tape itself act as an electrode by using a conductive backing for the polishing and texturing tape and ensuring the tape's structure allows the passage of liquid. Another way of forming an electrode is to place a metallic tape on the reverse side of a liquid-permeable tape and moving them along together. In all cases, it is essential that the object being processed and the electrode (cathode) be joined together by the electrolytic solution.

(0006)

Synthetic resin film is useful as the tape-shaped backing for this invention's combination electrolytic polishing and polishing and texturing tape. A typical example of this is 100 - 200 μm thick polyethylene terphthalate (PET) film, in which holes may be punched in a specific pattern as necessary. Film to be used may be selected from materials which have the necessary mechanical strength, and which can withstand environmental conditions including electrolytic solution.

(0007)

All types of woven material and non-woven cloth may also be used as the tape-shaped backing. Some of the liquid-permeable textiles include loose-weave woven material, knitted material, non-woven cloth, materials that have internal space, or comparatively densely-woven material and non-woven cloth in which holes have been punched. Textiles may be chosen at discretion as long as they have sufficient mechanical strength and chemical resistance, with polyester textiles being particularly suited. The width of the texturing tape is generally 35 - 89 mm, but it may be cut to fit the size of the disk.

(0008)

Either the entire surface, or most of the surface, of one side of this invention's texturing tape is covered with a layer which is capable of holding polishing grains. Diamond, alumina or other granules of an average diameter of no more than 3 μm are used as the polishing grains, with these being dispersed in an emulsion liquid, combined with electrolytic solution, and supplied to the space between the rotating disk board that is being polished and this invention's texturing tape which runs in contact with this. Surface structures which will temporarily hold polishing grains in the texturing tape surface to allow effective polishing of the disk surface at this time include porous synthetic polymer foams or flocked surfaces.

(0009)

The flocking process involves pre-coating the surface into which fibres will be flocked with a binder resin, flocking extremely short fibres in this surface through the use of static electricity, and fixing them in place with the binder resin. Fibres for flocking include polyamide, polyester, acrylic and other fibres which do not readily conduct electricity and are not affected by electrolytic solution, with fibres of no more than 1 denier and no longer than 1 mm being well suited. A base resin of acrylic ester emulsion blended with epoxy resin and a catalyst as a cross-linking agent can be used as an appropriate binder, but this is not the only possibility. When flocking is done to a specific pattern, methods such as the rotary screen method are used to print the binder resin in the pattern. The entire surface may simply be coated when the tape-shaped backing has already had a pattern of holes punched in it.

(0010)

For the porous synthetic resin foam, create a porous resin layer with a known foaming agent, such as synthetic resins such as polyurethane, polyvinyl chloride, polyethylene, polystyrene and polyvinyl formal, and foaming conditions, to make the surface porous apart from the outermost layer. Use such methods as the rotary screen method mentioned above for specific patterns.

(0011)

When using conductive tape-shaped backing or an electrode on the reverse side of the tape, it is preferable that the electrical resistance in the direction of the thickness of the texturing tape, which is formed from this layer and the tape-shaped backing, is at least $1 \times 10^{10}\ \Omega$, in the flocking or in the porous resin. This is because when this layer has good conductivity, a short circuit is formed between the electrode and the disk board, current ceases to flow in the electrolytic solution, and electrolytic polishing is interrupted.

(0012)

To ensure that there is no unevenness in the surface which is being polished or textured, for the pattern of the surface which is capable of holding polishing grains, it is necessary to use a position in which a mostly uniform contact area can be obtained in the width direction of the surface of the object being polished vis-à-vis the running of the texturing tape.

(0013)

ACTION

In the polishing and texturing processes by tape with a metallic surface in this invention, the object being processed acts as the anode, a cathode is positioned close to the surface being processed to conduct electrolytic polishing, and a solution of combined electrolytic solution and processing solution is present between, and in contact with, the surface being processed and the cathode; in doing so it is possible to conduct electrolytic polishing simultaneously with polishing and texturing, resulting in dramatic improvement in surface performance, such as smoother processed surfaces and greater uniformity of texturing, and also a significant boost to processing efficiency.

(0014)

EMBODIMENTS

Embodiment 1 of this invention will be explained with a texturing process example. After passing a 300 mm wide, 150 μm thick piece of polyethylene terphthalate (PET) film through a static electricity flocking device and coating it with an acrylic ester emulsion-type binder in the coating part, it was flocked with a pile of 0.5 denier, 0.2 mm long nylon fibres, and heat-cured to fix the pile. Ten holes of 2.4 mm in diameter per 20 mm x 20 mm square were created in the flocked film, and the film cut down to 37 mm in width to make texturing tape.

(0015)

Diagram 4 explains the simultaneous processes of texturing using this texture tape and electrolytic polishing. Texture tape (1) runs along in contact with rotating disk board (7), with metallic pressure roller (8) pressing the tape against the surface of the disk from behind. Whilst electrolytic solution (10), into which polishing grains (9) have been dispersed, is supplied to the space between rotating disk board (7) and running texture tape (1), a voltage is applied between disk board (7) and pressure roller (8) for simultaneous texturing and electrolytic polishing.

(0016)

Diagram 3 shows a different simultaneous process. In this example, an electrode referred to as cathode rod (11) is set in a position close to the front side of the texturing tape, with the cathode rod and the surface being processed being connected by electrolytic solution (10). Results of processing with this composition were similar to those in the previous item.

(0017)

Measurement of surface properties of disk boards processed in the aforementioned manner gave surface roughness, Ra, as 7 Å, and maximum surface roughness, Rp, as 10 Å, which are naturally far superior in comparison to the values of 20 Å and 100 Å, respectively, obtained when only mechanical texturing was conducted, and markedly better results were able to be obtained in a short period of time than when normally conducting texturing and polishing over two stages.

(0018)

EFFECT

This invention's texturing tape enables simultaneous mechanical texturing and electrolytic polishing, resulting in at least comparable, if not superior, surface properties with one-stage processing than conventional two-stage processing methods; that is grooves and ridges are even, and there are no abnormal protrusions. The efficient supply of hard disks without the occurrence of read-write (R/W) errors has, therefore, become possible.

SIMPLE EXPLANATION OF DIAGRAMS

Diagram 1

Cross-sectional, explanatory diagram of the embodiment of this invention's texturing tape.

Diagram 2

Cross-sectional, explanatory diagram of other embodiments of this invention's texturing tape.

Diagram 3

Explanatory diagram for this invention's process of simultaneous texturing (using texturing tape) and electrolytic polishing.

Diagram 4

Explanatory diagram of another composition for this invention's simultaneous texturing (using texturing tape), and electrolytic polishing.

EXPLANATION OF SYMBOLS

1 Texturing tape
2 Porous tape backing (film)
3 Binder resin layer
4 Flocked fibres
5 Porous tape backing (non-woven cloth)
6 Porous synthetic resin foam
7 Disk board
8 Pressure roller
9 Polishing grains
10 Electrolytic solution
11 Cathode rod

Control No. KC9708-1

Claims

CLAIM 1

What is claimed is a combination electrolytic polishing and polishing and texturing machine, comprising a polishing and texturing process with tape with a metallic surface in which the object being processed acts as an anode, and a cathode is placed near the surface being processed to conduct electrolytic polishing, with a solution of combined electrolytic solution and processing solution present between, and in contact with, the surface being processed and the cathode.

CLAIM 2

What is claimed is the combination electrolytic polishing and polishing and texturing machine in Claim 1, in which the cathode can be positioned on the side of the surface being processed.

CLAIM 3

What is claimed is the combination electrolytic polishing and polishing and texturing machine in Claim 1, in which the cathode can be positioned on the reverse side of the surface being processed.

CLAIM 4

What is claimed is a combination electrolytic polishing and polishing and texturing tape use in the combination electrolytic polishing and polishing and texturing machine in Claim 1, in which there is a layer on one surface of a tape-shaped backing of synthetic resin film, woven material or non-woven cloth, which has a surface that is capable of holding polishing grains.

CLAIM 5

What is claimed is the combination electrolytic polishing and polishing and texturing tape in Claim 4, in which the surface that is capable of holding polishing grains is comprised of a binder resin layer and fibres that have been flocked in the surface of that layer.

CLAIM 6

What is claimed is the combination electrolytic polishing and polishing and texturing tape in Claim 4, in which the surface that is capable of holding polishing grains is comprised of a porous synthetic resin foam.

CLAIM 7

What is claimed is the combination electrolytic polishing and polishing and texturing tape in Claim 4, Claim 5 and Claim 6, in which the electrical resistance (in the direction of thickness) of th part that has the surface which is capable of holding polishing grains is at least 1×10^{10} Ω, and the tape is liquid-permeable.

CONTROL NO. KC9708-1

Document Name Diagram

Diagram 1

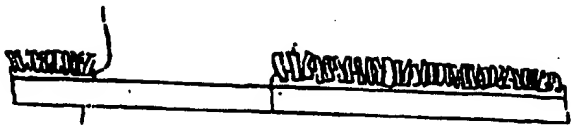
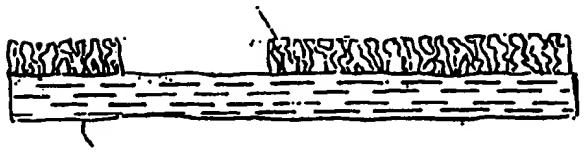
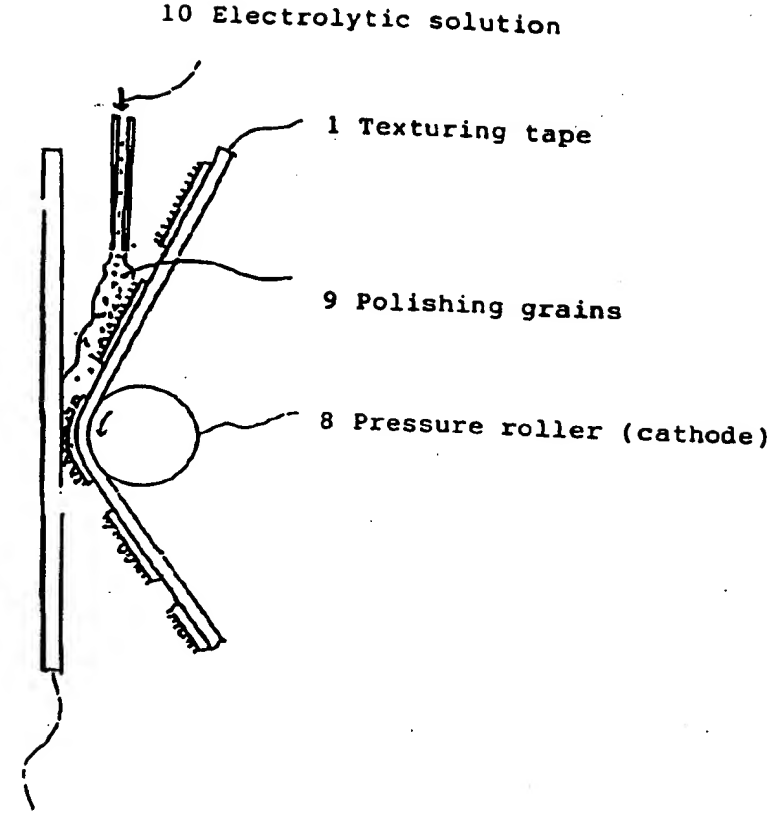


Diagram 2



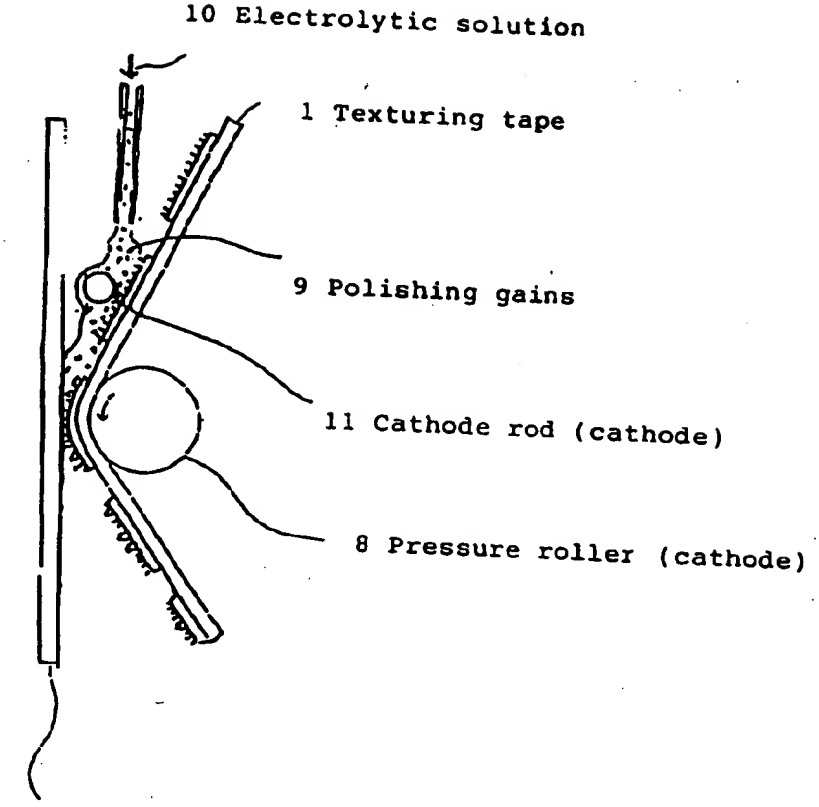
CONTROL NO. KC9708-1

Diagram 3



CONTROL NO. KC9708-1

Diagram 4



INTERNATIONAL SEARCH REPORT

Inte onal application No.
PCT/SG 97/00051

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: C 25 F 3/16,7/00; B 23 H 9/00; B 24 D 17/00,18/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[6]: C 25 F 3/14,3/16,7/00; B 23 B 9/00; B 24 D 17/00,18/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Database WPI on Questel, week 9325, London: Derwent Publications Ltd., AN 93-201550, Class L03, JP 51-28506 A (MATSUSHITA ELEC IND. CO., LTD.), abstract.	1-7
A	WO 93/14 249 A1 (LEONARD) 22 July 1993 (22.07.93), abstract.	1-7
A	WO 88/00 871 A1 (JORDAN) 11 February 1988 (11.02.88), abstract.	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 October 1998 (05.10.98)	13 October 1998 (13.10.98)
Name and mailing address of the ISA/ Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Lux Telephone No. 1/53424/434

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int[illegible]ional application No.

PCT/SG 97/00051

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
WO A1 9314249	22-07-93	AU A1 32631/93	03-08-93
		GB A0 9200494	26-02-93
WO A1 8800871	11-02-88	AT E 86903	15-04-93
		DE A1 3626966	18-02-88
		DE C2 3626966	13-12-90
		DE C0 3784904	22-04-93
		EP A1 276264	03-08-88
		EP B1 276264	17-03-93
		ES AF 2007395	16-06-89